

Seasonality and Environmental Impact Status of Polyethylene (Cellophane) Generation and Disposal in Benin City, Nigeria

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ABSTRACT This paper investigates the environmental impact and seasonal variation of polyethylene (cellophane) generation and disposal in Benin City, Nigeria. Cellophane was generated from seven randomly selected markets. Two hundred and fifty respondents in the markets were given questionnaire and two wastebaskets each to determine the rate and types of cellophane generated in the markets and their homes. The results show that polyethylene is generated more during the dry season months (November – March) than the wet season months (April to October). Evbarake Spare Parts Market, which is not a foodstuff market, and also dominated, by male traders, registered the highest cellophane generation and disposal (51.31kg), followed by Oliha (48.72kg), New Benin (37.53kg) and Aduwawa (32.71kg). Based on the type of cellophane, table water sachet topped the list followed by cellophane for assorted items, ice cream and biscuit wrappers in that order. Polyethylene generation was higher in the markets than at home. At home and in the market an individual generated 4.85 (55.29kg), 145.8 (1.66kg) and 1749.6 (19.945kg) daily, monthly and annual bases. Cheapness and availability are some of the reasons for constant patronage of cellophane. Indiscriminate polyethylene disposal has constituted environmental nuisance and degradation. For cleaner and sustainable environments, vigorous enlightenment campaign, proper collection techniques and recycling among others are recommended.

INTRODUCTION

Until recently, polyethylene (cellophane) papers do not have serious negative environmental problem in the developing countries simply because of the subsistent pattern, small scale agricultural and industrial production and, consequently, low quantity of waste generation. Besides, when generated, land was generously available for the disposal of waste. Hence simple disposal techniques such as return to land use of adjacent field, and indiscriminate burning and dumping were adopted for waste disposal (James, 1981; George et al., 1993). Unfortunately, these techniques could no more accommodate the present waste disposal problems because of rapid population growth and industrialization which are the two major factors competing for land (John and Williams, 1993). The two major factors have greatly increased the volume of polyethylene (cellophane) generation. If this is the present situation, it would mean that the coming generation will have to face and contend with unprecedented environmental problems and challenges. This scenario is aptly reported in World Development Report (1992) when it stated that: “Between 1990 and 2030 as world population grows by 3.7 billion, food production will need to double and industrial output and

energy will probably triple world-wide and increase five-fold in developing countries”.

This growth signals some disheartening message because as reported by the Awake (2002): “This growth brings with it the risk of appalling environmental damage because as population increases the rate of food consumption increases and this will be manifest in high waste generation”

In traditional African Society, with lower population figures, the native leave was sufficient for all that the individual needed to wrap (Jimoh, 2000). But the challenges of ever increasing population have made Nigerians to learn how to use the fairly improved means of wrappers such as the polyethylene bags. Polyethylene (cellophane) papers are currently being used in all forms and shades in Nigeria as wrappers ranging from biscuit, ice cream, table water, salt, and tapes (audio and video) to mention but a few. Cellophane bags are used virtually in all shopping centers, homes, markets, restaurants and farms in Nigeria (Ogunna, 1990). Polyethylene materials, which are derived from ethylene polymers, are products of the polymers industry at present. They possess certain qualities and properties which make them readily usable. These include high tensile, stiffness, compressive strength and impact resistance. The high physical strength and properties are reproducible

and predictable as well. They also retain their physical and chemical properties over a wide range of environmental conditions such as heat, cold and chemicals. They can resist mechanical stress for a very long period of time. Flame retardness is not an essential requirement but it has become an added asset lately. They are not biodegradable since they are unaffected by heat, cold and chemicals (Obediah, 2001). Recently, it was reported that this year's Nobel Prize for chemistry was shared by three distinguished scholars because of their discoveries, which help industries to produce advanced plastics among other things (The Guardian, 2005). This is a pointer to the fact that the world will, in due course, have more of cellophane and plastics to contend with environmentally.

Polyethylene is found in the entire streets, nooks and crannies of Edo State. They therefore pose serious environmental problems to inhabitants especially where solid wastes are deposited in towns (urban areas) and villages (rural areas). Urban waste disposal is the responsibility of various municipalities, local government and/or city co-operations (Ramasastry, 1988). Most of the developing nations' urban waste disposal systems are anything but functioning. Where they function however, they are grossly inadequate despite today's technological know-how and renewed efforts towards effective waste disposal (Aziegbé, in press).

A lot of studies abound that focus attention on solid waste generation and disposal in Nigeria cities. Examples include Adedibo (1983) study of Ilorin and Offa, Kwara State; and Oyinlade (1991) study of Akure, Ondo State. Studies of waste generation and disposal with a focus on the Nigeria landscape include Onokerhoraye (1984); Omuta (1988); Dede (2000) and Fodeke (2002). In Edo State, and with particular attention to Benin City, it will include the study of Akpovi (1981), Ukut (2001) and Ramasastry (1988). A central theme that runs through these studies cited is that they examined generally, solid waste generation and disposal systems. None has yet, focused on the generation and disposal of polyethylene papers and its environmental impact status within the contexts of aesthetics and environmental degradation. This knowledge gap specifically represents the focus of this study. Essentially therefore, the objectives of this study are to: examine the

seasonal variation in the generation and disposal of polyethylene papers; to compare the quantity of polyethylene generated and disposed off both at homes and market centers, and, to examine the risks posed by polyethylene environmentally for human beings. All the aforementioned were rigorously examined in Benin City, Edo State, Nigeria.

THE STUDY AREA

Benin City is the study area, and it is the capital of Edo State, Nigeria. It is located between latitudes 6°17' and 6°26' North, and longitudes 5°35' and 5°41' East (Fig. 1a and b). Benin City is unique because it is a nodal town that links the Northern, Southern and Western parts of the country. It is a commercial as well as industrial town with some 20 daily markets. Benin City is found on the equatorial climatic belt precisely on the A_w Koppen's zonal classification scheme with summer rains and winter dryness. Although there is hardly any month without rainfall, the concentration is between the months of April and October (wet season) and, the dry season is prevalent between the months of November and March. The mean annual rainfall is well above 2000mm with relative humidity that is above 70%. Temperature is high throughout the year with a mean of 28°C. This seemingly high temperature, no doubt, permits the demand for cold sachet water, ice cream as well soft drinks (minerals of all kinds).

MATERIAL AND METHODS

Two major approaches were adopted in acquiring the data used for this study. Seven daily markets, namely, (New Benin, Oba, Uselu, Oliha, Aduwawa, Evbareke and Eki-Osa, (Fig. 1c) were randomly selected for data collection. In each market, two areas measuring 30 metres by 100 metres were demarcated in such a manner that one was in the raw food section and other in the processed food items (provision stores) section. In the Evbareke market where there was no foodstuff section, the same two areas with the same dimension indicated earlier on were equally demarcated. In each market, one of the cleaners (sanitation personnel) was made to sweep the demarcated areas daily and was instructed to always select the cellophane from other wastes. These were stored in special refuse

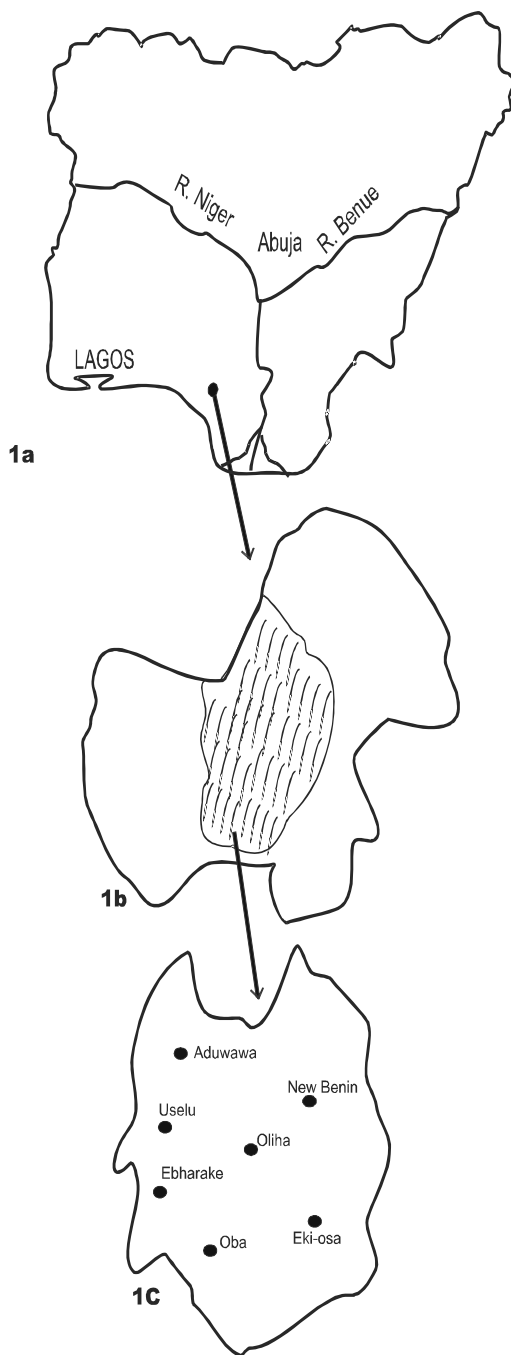


Fig. 1a. Map of Nigeria showing Benin City
 Fig. 1b. Map of Benin City showing studied area.
 Fig. 1c. Map of studied area showing the markets.

collection bins, and were measured weekly using Salter Thermoscale. And because it is also within the scope of this study to determined and compare the amount of cellophane generated at homes and in the markets, 500 waste paper baskets were distributed to 250 respondents approached previously to participate in this study. Each participant was given 2 waste paper baskets. While one of these baskets was to be placed and monitored in the markets, the other is to be used at homes. For the purpose of standardization, the number of those in each store or household divided the cellophane generated. Data were collected from January 2005 to December 2005. The data were analysed using percentages and graphs.

The author is deeply aware that cellophane is generated and disposed indiscriminately anywhere the consumer finishes with it (along the street, inside public transport system, parking lot, garage and so on). However, this study concentrated only in the markets and at homes because these areas are the major generating and disposing points.

RESULTS AND INTERPRETATION

The monthly distribution of cellophane in all the markets combined is shown in figure 2. The pattern displayed showed a rise in cellophane generation and disposal from January to March, which had the highest peak of 20.61kg. Thereafter, there is a gradual declining trend until June (15.86kg), which experienced the least generation and disposal. The rise in trend continued again until the month of December, which had the

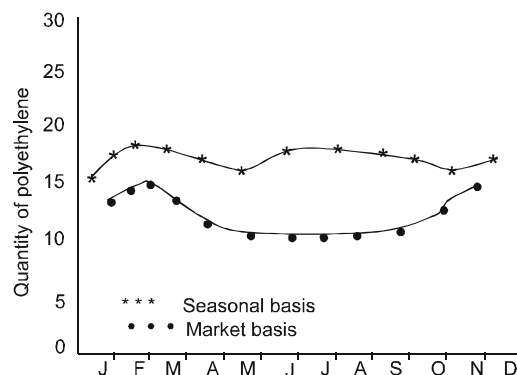


Fig. 2. Variation in polyethylene generation and disposal

second peak (18.53kg). Seasonal variation showed that cellophane generation was highest during the dry season (16.75kg) month of November to March and lowest during the wet season (12.58kg) months of April to October. Akitikpi (1999) reported similar result for Warri when he observed that solid waste generation is higher during the dry season than in the wet season.

On market basis, Evbareke Spare Parts Market has the highest total cellophane generation and disposal (51.31kg), Oliha is next with (48.72kg). This was followed by New Benin (45.62kg), Eki-Osa (43.57kg). A similar pattern of monthly distribution of polyethylene was noticed in these markets. Some market like Evbareke, New Benin and Eki-Osa are mostly affected by seasonal variation, while it was almost uniform in Oba and Aduwawa markets. All the markets recorded the peak of polyethylene generation in the month of March but the least generation and disposal did not take place in a single month. While the least disposal occurred in the month of June in Uselu, Oliha, Evbareke and Eki-Osa, it was July and August in New Benin, Oba and Aduwawa markets respectively. Evbareke ranked first in waste generation. The reason that could be responsible for this is that the market population comprised of mainly men who depend almost entirely on food items wrapped with polyethylene. Oba, Uselu and Aduwawa markets, which recorded low cellophane generation, are more of foodstuff markets where women traders dominate. Though, they use a lot of polyethylene in the sales of their foodstuff, most of these polyethylene are not deposited in the markets but are taken home. Moreover, most women cook their food at home and bring them to the market in plastic food containers thus reducing the rate of consuming cellophane wrapped foods in the market.

The polyethylene collected were sorted and counted. The result shows that table water sachet topped the list, and following that order of descending magnitude is ice cream and biscuit wrappers (Table 1). Table water sachet topped the list because; it is consumed throughout the year with very little seasonal variation. Again, the studied markets have no public portable water system where the traders can get their drinking water. As a result, majority of them depend on the sachet water on a daily basis. Some traders who take their drinking water to the

market from home soon discover that the water become too warm and unfit for consumption in the afternoons particularly on sunny days. Consequently, they resort to the cold sachet water that is being hawked all over the market.

Ice cream wrappers exhibited the highest variation in this study. Their generation and disposal are readily compared both during the dry months and the heart of the wet season. Polyethylene for assorted items also exhibited high seasonal variation. This implies that its demand and consumption is almost uniform throughout the year. Dede (2000) reported similar finding for Ibadan. She noted that among the non-biodegradable solid wastes generated, cellophane is mostly affected by seasonality. This kind of seasonality impact was reported for sachet water, newspaper and recreational participation in Warri (Odjugo, 2004).

Polyethylene generations are not restricted to markets and streets alone but are also generated at homes. Consequently, this study attempted to make some kind of comparison between the nature of polyethylene waste generated at home and, in the market.

The same monthly pattern of generation was out-rightly higher for markets than homes. The possible reason could be that, at home most food is served with plates instead of wrappers. This has a way of reducing drastically the amount of cellophane generated as compared to the markets where most of the cooked food or snacks are served in polyethylene. Types of cellophane generation at home and market also displayed a very interesting pattern (Table 1).

Table 1: Comparison between polyethylenes wastes generated at home and market.

<i>Polyethylene Types</i>	<i>Home (Kg)</i>	<i>Market (Kg)</i>
Assorted	98,361	51,000
Biscuit wrappers	45,263	60,863
Ice cream sachets	35,514	81,562
Table water sachets	25,360	96,361

Source: Fieldwork, 2005.

In ascending order, it shows that polyethylene for assorted items was the least (51,000), followed by biscuits (50,863), ice cream sachets (81,526) and table water sachets (96,853) in the market. At home, the trend displayed, when arranged in descending order, shows that polyethylene for assorted items was the highest (98,361kg), closely

followed by biscuit wrapper (45,263), ice cream wrappers (35,514) and table water sachets (25,360). Cellophane for assorted items ranked lowest in the market because they are used in wrapping items in the market but disposed off at home having removed the contained items for cooking or storage. The generation of table water sachets was lowest at home but highest in the market. This is so because most homes have refrigerator where they can store water for it to get cool/cold. This finding is in agreement with Tanko's (2001) study in Yola, northern Nigeria, where he reported that cool sachet water and ice cream are sold more at markets and schools. The mean number of individual polyethylene generated was also examined. Cellophane for assorted items was generated more at home while the least generated is ice cream sachets. At the markets, table water sachets topped the list with a mean of 1.05 and the least was for assorted items with a mean of 0.25. Both at home and market, the daily mean of cellophane generated by individual stood at 4.48 while the monthly mean is 145.8 and annual mean is 1749.6.

Further analysis showed that an individual generated and disposed 19.945kg of cellophane annually (Table 2).

Table 2: Measured and Estimated amount of polyethylene generated by individual, Benin City, Edo State and Nigeria.

Category	Estimated Population (m)	No. of polyethylene (b)
Individual *	individual	19.945kg
Benin City **	2.1 million	2.10 billion
Edo State **	3.8 million	6.648 billion
Nigeria **	120 million	20.40 billion

* = Measured ** = Estimated

Source: Fieldwork, 2005

Using this individual mean, estimates were computed for Benin City, Edo State, and Nigeria (the entire country). Benin City with estimated population of 2.1 million (Census News 2002) generated 2.10 billion or 24 thousand tones of cellophane. Edo state on the other hand with 3.8 million people in the same year, generated 6.648 billion or 76 thousand tones of cellophane, while the entire country with estimated population 120 million generated 20.40 billion tones of cellophane. With these figures, one can begin to imagine the number or volume of cellophane being generated and disposed in Nigeria in its environmental context. The questionnaire survey further reveals

that 82% of the respondents prefer the use of polyethylene as wrappers to newspapers and natural leaves because they are cheaper. Some 80% prefer polyethylene wrappers because they are relatively cheaper with high aesthetic value. Only 15% showed preference for local leave as wrappers, and these were mainly the aged ones. The group identified added taste and aroma as reasons for their choice of local leaves. They also see the leaves as medicinal. It should be noted that much as these respondents would want to use local leave as wrappers, they also see the need for modern wrapping materials like cellophanes, newspapers, old textbooks and magazines among others.

Basically, all the respondents agreed that they use the polyethylene for wrapping fish, crayfish, meat, boiled and raw rice, beans, eggs and numerous form of processed food. Exactly 97% agreed that they use larger cellophane to carry goods from the market and shopping centers, to raising seedlings and flowers. On the frequency of using cellophane before disposal, all the respondents agreed that they use it for a number of times so long as the cellophane is in good condition. When respondents were asked the question "why do they dispose off cellophane indiscriminately"? The most outstanding reasons given include lack of waste bins in private and public places/vehicles; poor attitude of Nigerians towards waste disposal and environmental sanitation, no adequate punishment for environmental violators/abusers. Personal observation and experience reveal that virtually every Nigerian is guilty of this indiscriminate waste disposal since both the educated and illiterate, rich or poor, old or young throw away any waste anywhere and anytime he is done with the content.

ENVIRONMENTAL PROBLEMS OF CELLOPHANE AND MANAGEMENT

The environmental problems associated with cellophane are numerous and varied. For example, a glass bottle thrown into the sea takes 1000 years to decompose. In contrast, paper tissues decompose in only three months. A cigarette butt pollutes the soil or sea for upward of 5 years; plastic bags take 10 to 20 years; nylon papers (where polyethylene belongs) take 30 – 40 years; cans, 500 years; and polystyrenes, 1000 years (Awake, 2002). Nylon or cellophane is non-biodegradable but its strength while in water or

soil deteriorates with time. During the deterioration period, the chemicals with which, the cellophane is composed are gradually released and thus polluting the soil or water for upward of 40 years. With this in mind, and going by the volume of cellophane dumped into our water bodies, and land, one became worried with the magnitude of environmental pollution in Nigeria in the coming years. One is not particularly certain, when exactly, the use of cellophane started in this country but, what cannot be disputed is that its usage and the concomitant environmental pollution has been on steady rise since the 1970s when rapid urbanization, bludgeoning socialization, serious cultural integration and technological development resulted in a shift in the average Nigeria life style. This shift in life style from the traditional to the Western ways of living and feeding, together with the placement of aesthetics over and above the use of natural leaves as wrappers, accounted for some of the basic reasons for the continued patronage and use of polyethylene in Nigeria. Since polyethylene is not recycled in Nigeria or adequately disposed off, they are ever present on the landscape not-with-standing whether it is rural or urban. The environment is therefore, filthily coloured with all shades of polyethylene resulting in a drastic reduction of environmental aesthetics. This form of eyesore resulting largely from environmental abuse and degradation is worst in urban areas. The polyethylene is also capable of holding rain for days, weeks and months. These small pools of water are usually breeding ground for mosquitoes thereby increasing the incidence of malaria in Nigeria.

As at yet, the type and magnitude of soil and water pollution in Nigeria is not fully known. However, there is the fear that if the situation is not checked immediately, chances are that our environment will become seriously unsustainable in the future. To guide against this, it is suggested that appropriate measures be put in place to properly dispose the non-biodegradable items. In furtherance of these measures, it is advocated that aggressive campaign and enlightenment of the masses on the dangers of cellophane be carried out. This can be achieved through public lectures, jingles and adverts as the case may be. This approach, it is hoped, will certainly change their current attitude as it pertains to indiscriminate disposal of cellophanes. Government should provide public waste bins in strategic positions along the streets, and other

public places. These waste bins should be collected and adequately disposed off regularly. More personnel should be employed in the Ministry of Environment. Environmental Health Officers and equipments should be strengthened to be able to meet the demand of the present environment within the context of waste disposal. Currently, manpower and equipment are grossly inadequate in this ministry (Aziegbé in press). People who are found to be physically abusing the environment should be arrested, charged and punished if found guilty. The hitherto monthly environmental sanitation programme should be reintroduced. It is equally advocated that the recycling aspect of the cellophane should be seriously considered. The government can do this by contracting cellophane collection and disposal out rightly. If this is done, and the people are aware that they will be paid for used cellophane, they definitely will be encourage to preserve the ones used. This will create a means of sustainable employment for the women, children and the generally unemployed. Besides, our environment will be the better for it in terms of pollution and degradation. This is in line with the submission of Fodeke (2002) when he said “garbage is money, don’t throw them away”, and as observed by Awake (2002), “we should avoid the throw away mentality and adopt the refuse and recycle syndrome”.

Apart from the suggestions made above, the recommendation is here made for biodegradable polyethylene instead of the present non-biodegradable ones.

CONCLUSION

Polyethylene generation was found to be higher during the dry season months (November – March) than the wet season months (April – October) with the least in the month of June. None foodstuff markets dominated by male traders who depend solely on wrapped food items with polyethylene had the highest cellophane generation. Cellophane generation was also higher in the markets than at homes. This is so because at homes, most food is served with plates and the consumption of table water and ice cream are considerably reduced. A larger proportion of the respondents prefer the use of polyethylene as wrappers, to newspaper and local natural leaves because of its cheapness, neatness and readily availability. Generally, respondents use

polyethylenes for shopping, raising young seedlings, flowers and as, traveling bags. Some of the reasons given for improper disposal of polyethylene include environmental care-free attitude of Nigerians, non-availability of refuse bins in public and private places, as well as no punishment for environmental abusers and violators.

Polyethylene is a major source of environmental degradation in Nigeria, and this form of environmental abuse is worst in the urban areas. The water held by cellophane serves as breeding ground for mosquitoes thereby increasing the incidence of malaria, which is the leading killer disease in Nigeria today.

For a cleaner and sustainable environment therefore, massive awareness campaign and enlightenment about the danger cellophane poses to our environment should be vigorously carried out. Government should provide public waste bins in strategic positions for the collection of wastes. The Ministry of Environment should employ more personnel. The government and individuals should look at recycling option of polyethylene

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